APPLICATION FOR LETTERS PATENT

FOR

WIRELESS PHONE WITH INTERFACE TO DIFFERENT NETWORKS

BY

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TECHNICAL FIELD

This invention relates to telecommunications, and more specifically, to an improved wireless communications device capable of interfacing to digital data networks and analog or digital wireless telephony networks such as CDMA, TDMA, GSM, and other types of such wireless telephony networks. The invention also relates to a technique of automatically roaming between the two types of networks and other communications networks as well. A networking system in which the inventive device may be utilized is also disclosed.

BACKGROUND OF THE INVENTION:

Wireless communication devices have become prevalent over the past several years, with most individuals utilizing one or more such devices such as cell phones, wireless e-mail devices, etc. Most such devices are capable of access over a wide geographic area that can often include either an entire continent, or even most of the world. Utilizing a cell phone as the illustrative example, the communications systems require that the phone be located and tracked on a variety of wireless telephony networks that are foreign to the cell phone's "home network".

The home network is a network or small portion thereof associated with the carrier that provides the service to the cell phone, and is usually limited geographically or by other means. For purposes of explanation herein, we define a "roaming network" as a network covering an area where the cell phone or other device is located when it is not located on its home network. For example, if a cell phone is serviced by Verizon, it may be on its home network whenever it is within the portion of the Verizon network that is within the northeastern United States. However, when the cell phone is located in Mexico, and it must connect to the network via a Mexican cellular network, it is said to be roaming, or on a roaming network; i.e.; a network other than the basic northeastern United States coverage area. Additionally, if the cell phone is used in Seattle, it is also said to be roaming because it is not directly connected to the "home network", the portion of the Verizon network covering the northeastern United States. Instead, it may be

connected to a different portion of the Verizon network. The foregoing two types of roaming are termed on network roaming (e.g.; Seattle, where the user can connect to the Verizon network, but not to the portion that includes his normal coverage area) and off network roaming(e.g.; in Mexico). The present invention is applicable to both types of roaming, although we use off network roaming for exemplary purposes only herein.

Additionally, the user may be roaming even when he or she is physically within the purview of the home network. For example, the user may be connected via a roaming network because the home network is experiencing congestion or other problems, or because an alternative network is simultaneously available and is preferred for any of a variety of reasons. In the present specification, "roaming" is intended to cover any situation wherein the user is not directly connected to the home portion of the network, regardless of the reason why, and regardless of whether the cell phone is physically capable of connecting to that home network based upon its location.

Typically, an out of band signaling mechanism is used to allow communications with the cell phone when it is roaming. For example, the well-known SS7 out of band signaling protocol can be used by other networks to advise the home network that the cell phone is located within the service area of a roaming network. For example, consider a cell phone whose home network is a New York based wireless carrier. When the user of that cell phone travels to Mexico and uses the cell phone, the phone can still receive calls. This is accomplished because the cellular network in Mexico detects the presence of the cell phone and recognizes that the cell phone's home network is a New York based cellular network. The Mexican wireless cell network then uses out of band signaling, such as SS7, to advise switches in the New York based home network that the cell phone is presently located in Mexico. Calls that arrive for that cell phone at the home network are then forwarded via the public switched telephone network, to the Mexican cellular network, for completion to the subject cell phone.

Although the foregoing system is acceptable in most cases, it fails to utilize existing technology with respect to IP networks, such as wide area packet switching networks, including, but not limited to, the Internet, to maximize efficiency. More specifically, the foregoing prior art systems provide little or no mechanism for maximizing usage of packet switching in the Internet and other IP networks, and no

technique of taking advantage of the resulting reduced costs and/or expanded coverage areas where there may be Internet access but no cellular coverage.

Presently, there exist Internet Protocol (IP) wireless devices, which communicate over packet switched data networks using a wireless mode. These devices may also roam to various other networks and service providers. However, unlike the case of cell phones, there is no technique for easily merging the widespread deployment of cellular networks typically utilized for telephones with the packet switching data networks utilized for wireless IP devices. Consequently, existing networks and systems fail to take advantage of the ability to merge the advantages of many different types of networks and devices.

Travelers with IP devices are also often able to log on to the Internet through wired connections to local area networks in homes and offices they are visiting, in hotel rooms, and in their own homes. Currently, they have no way to take advantage of these connections using their cellular voice phones.

In view of the foregoing, there exists a need in the art for combining the use of both wireless cellular networks previously intended for telephony applications and wireless IP networks previously intended for use with wireless IP devices but not specifically designed for voice service to give wider coverage for voice and other applications. There also exists a need to allow cell phones to connect though wired Internet connections.

SUMMARY OF THE INVENTION:

The above and other problems of the prior art are overcome in accordance with the present invention. The inventive method and apparatus comprises a telephony device that can interface to an IP network. Instances of the device may connect to an IP network with a wireless protocol such as 802.11 or a wired connection such as Ethernet or both. The device can also interface to a typical cellular telephone network either on its own or through the attached cell phone. Depending upon location and configuration programmed by a user, the device may automatically select, or be configured to select, the appropriate network, whether an IP or cellular network. The device uses the

connector built into most cell phones and may be manufactured in variations to fit each model of cell phone. The device may provide power to the cell phone.

In an enhanced embodiment, the device may automatically utilize either type of network, and may either automatically or manually be configured to utilize the addressing system employed by any of the networks. Means are provided within the network for converting addresses between those utilized by each of one or more networks. Accordingly, the cell phone attached to the device may indirectly through the agency of the device use any of one or more different addressing systems, and conversion among the addressing systems may occur in one or the other network if necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a conceptual diagram of a cell phone of the present invention as used in a network system;

Figure 2 depicts an alternative embodiment of the present invention;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 depicts a block diagram of a system utilizing the teachings of the present invention. The arrangement of Figure 1 shows only small portions of the Public Switched Telephone Network (PSTN) and the Internet or other IP network **105**. It is understood however, that these portions of the PSTN **108** and IP network **105** are part of a much larger system of networks that span wide geographical areas.

Figure 1 includes a cell phone or similar device **101** and adaptor **102** to be further explained hereafter. A local area network, which may be wireless or hardwired, is represented by **104**, and serves to connect the adaptor **102** to an IP network access device **103**.

A server **106** interfaces with an out-of-band signaling network such as **110** which uses SS7 or some other telephony signaling protocol and an IP network **105** as shown.

The cellular network **112** is connected to various phones such as **111**, and switching devices such as **107**. An additional server **130** is also shown which is connected to IP network **105** and the PSTN **108**.

Adapter **102** is a relatively small device into which a cell phone **101** can be inserted. The adapter **102** contains a network interface to communicate over a Local Area Network (LAN) **104.** LAN **104** may itself be wireless, such as the WiFi type of network, or may represent any other type of LAN or other IP network. Adapter **102** serves to convert the typical cell phone protocol into the appropriate networking protocol utilized by network **104** and vice versa. It is also noted that while the adaptor **102** is shown as separate from the cell phone **101,** it is also possible to build the adapter and cell phone as one unit, so that the cell phone is capable of operating in plural modes, one of which includes a direct connection to an IP network.

In operation of the exemplary embodiment of Figure 1, when a user of cell phone **101** roams to an area covered by an IP interface, rather than, or in addition to, a cell network, the cell phone **101** may be converted for use as an IP phone and is still reachable at its assigned phone number and may make outgoing calls billed to its cellular account It is assumed for this example that the home network of cell phone **101** is cellular network **112.** The adapter **102** identifies the nearest access device **103** with which to communicate, and the network **104** over which such communications may take place. The identification of the interfacing network **104** may then occur automatically, as in adapter **102** detecting the carrier signal of the specified type, or may be done manually by the user configuring via switches or other means to set adaptor **102** to an appropriate network **104**.

The use of automatic selection of an appropriate interface can also prioritize various network interfaces in the event that plural such networks are available. For example, if a user is within range of a WiFi transceiver as well as a typical cell phone network transceiver, the user may set priorities as to which one would be selected first. Thus, the adapter **102** can be programmed to check first for WiFi, if it is available use it, and if not, check for an Ethernet, if not, check for a cell phone interface, etc. Additionally, rather than a fixed set of priorities being established, the user may establish rules and logic to allow the device to select the most efficient network. For example,

signal strength, cost differences, whether the call is inbound or outbound, or other criteria may be accounted for in the network selection. In any event, adaptor **104** eventually determines that it is interfacing to an Ethernet, for example. After the appropriate network selection is made, communications are established between adaptor **102** and server **106** thru access point **103** and IP network **105**

Adaptor **102** signals to cell phone **101** that a signal has been detected from a "tower" (actually Server **106** in the case where an IP network has been chosen) and cell phone **101** than transmits its identity to adaptor **102**. Adaptor **102** translates the cell phone protocol identity sequence to IP packets and sends them to server **106**. Server **106** recognizes that cell phone **101** is roaming from its home network from the identity information that has been sent.

Notably, the "roaming" may take place even when the cell phone and its user are physically located within the home coverage area of the cell phone user so long as the cell phone is also located within the coverage of a WiFi receiver or other IP access point, and the cell phone **101** has been configured to select the IP network with which to communicate, rather than the cellular telephony home network. This situation is also intended to be included in the definition of "roaming" because the cell phone is not obtaining network access through the usual portion of the cellular telephony network associated with the cell phone as its home network.

Continuing with the description of Figure 1, the information conveyed by cell phone **101** to server **106** is sufficient for server **106** to identify the home network of cell phone **101**. Such information may include an identification of the actual home network of cell phone **101**, of a specific server or switch on the home network **112**, and/or other identifying information to assist the server **106** in establishing communications with the home network of cell phone **101.**

Server **106** may then communicate to a switch and/or server **107** in the home network **112**. After server **106** detects the relevant information from cell phone **101**, it transmits messages through server/switch **107**, informing server/switch **107** that cell phone **101** is presently communicatively coupled to IP network **105** rather than to its home network **112**. This information can flow from server **106** to server **107** via a plurality of mechanisms. For example, SS7 signaling, an out of band signaling protocol

typically used for call setup in conventional telephone networks, can be used. This information may also flow using any other out of band protocol, IP connections using public and/or private data connections such as the Internet, the PSTN, or any of a variety of other techniques. Further, this information may, but does not need to, include other information indicating that the network **105** is an IP network.

In one or more embodiments, the SS7 signaling is used between the IP network **105** and home network **112** may be identical to existing SS7 signaling, resulting in cellular networks being able to advantageously utilize the invention even if they only implement standard, prior art SS7 signaling. In other embodiments, more advanced signaling conveying other billing and identification/authentication information may be used. For example, **110** may represent an IP connection, over which server **106** transmits the appropriate authentication/identification information, billing information, etc. The communications line **110** is not intended to imply or be limited to any type of connection, and both the media and protocol utilized thereon may vary.

Regardless of the signaling used, switch/server **107** is eventually given a new phone number representing an entry point into IP network **105** servicing the cell phone **101**. In the example of Figure 1, switch/server **107** could be given a telephone number representing server **130**. Preferably, server **130** is deployed such that only a local call over PSTN **108** is required to connect switch/server **107** to server **130**. When the incoming call arrives at network **112**, it will then be conveyed through server **107** and PSTN **108** to server **130**. Upon receipt of the call, server **130** would then utilize IP signaling via IP network **105** to contact server **106** for further instructions. In this embodiment, server 106 is acting as a "gatekeeper" as that term is used in standard protocols such as H.323. Server **106** would then convey to server **130** the IP address of adaptor **102**, so that server **130** would then have all of the information it needs to convey the call through access point **103** and adaptor **102** to the cell phone **101**. Alternatively, the address of adaptor **102** can be conveyed to server **130** in advance of the call arriving, although a mechanism for keeping such data current, such as periodic updates or updates whenever routing information changes, would have to be provided.

In any case, after switch/server **107** is advised of the number at which to contact an IP network **105** presently servicing the cell phone **101**, calls arriving from caller **111** to

home network **112** destined for cell phone **101** would be rerouted through server **107** to server **130.** As shown in the example of Figure 1, such rerouting may be accomplished in one example by transmitting the call over a line **113** to PSTN **108** for conveyance to server **130**. In another embodiment, servers **130** and **106** may be a single physical server.

It is noted that since either or both of switch/server **107** and servers **106** and **130** may be configured to communicate with various combinations of IP networks and telephone networks, plural techniques for routing the incoming call from home network **112** to IP network **105** may be utilized. Indeed, both the control and media associated with the call can be exchanged between the networks **112** and **105** using various combinations of in band and out of band signaling, IP and telephony signaling, and one or more intermediate gateways and switches

It is also noted that the addressing system utilized by cell phone **101** and implemented in the embodiment shown in Figure 1 may be its normal telephone number and/or other cellular identifying information. Adaptor **102** is identified on IP network **105** by an IP address. Server **106** performs the mapping between the IP address of adaptor **102** and the identifying information of cell phone **101**. Moreover, server **106** assigns an inbound telephone number associated with server **130** (or other server) on the PSTN and associates this with cell phone **101** and adaptor **102** for as long as they are roaming on IP network **105**. The IP address of adaptor **102** may be dynamically assigned by any component in the network, such as, for example, access server **103.** When a call is received by server **130** or some other server for the phone number associated with cell phone **101**, either the servers **106** or **130**, or some other device, translates that telephone number into the network address on network **104** at which the cell phone **101** can be found through adaptor **102**.

In operation, a call arriving from telephone **111** and directed to cell phone **101** is received in cellular network **112**. Cellular network **112** forwards the call to server/switch **107** for forwarding to a sever designated by server **106** (e.g. **130**) via links **113** and PSTN **108.** The call is then completed via IP network **105**, over the data network **104**, through the access point **103,** through adaptor **102,** and ultimately to the cell phone **101.** In the aforementioned process, server **106** provides the information to convert the dialed

telephone number into an IP address on IP network **105**. Such conversion is sufficient to route the call through IP network **105** to adaptor **102**. Access point **103** is connected to network **104** and thus has the appropriate addressing information to complete the call to adaptor **102**.

While the foregoing describes call flow in the case of an incoming call, the message and control flow for an outgoing call initiated by cell phone **101** is different. Referring still to Figure 1, in the case of outgoing calls, authorization information is requested from home network **112** either when the cell phone **101** first appears on the IP network **105** or when the call is being attempted. Such authorization may be requested by communicating with home network **112** using any of the previously described techniques.

If the call is authorized, it may be completed through server **130** or some other server designated by server **106** to the PSTN **108** in the normal manner and billing information may be transmitted back to home network **112** by SS7 signaling or in any other convenient manner. In the special case where the called number is also presently within the called purview of server **106**, or the purview of another IP network to which server **106** may connect, the call may be completed using IP all the way without ever utilizing the PSTN for the media and/or control stream

It is also noted that while the home network has been described as a cellular telephony network and the IP network is the roaming network, the invention is not so limited. An IP network may be utilized as the home network, and the cell phone **101** may be deemed roaming when it is on a cellular telephone network, or potentially other IP network. In this case, using present day protocols, the cellular network sends an ss7 message to the home IP network (which looks to it like another cellular network). The media server **130** associated with **106** owns the phone number of the called phone as far as the PSTN network is concerned. Whenever the server **130** receives a call (including cases above) it asks server **106** what to do with it. Server **106** will instruct it to forward the call via IP or PSTN as appropriate to the network onto which the user has roamed, which may be some other IP network, or the PSTN.

Figure 2 depicts an alternative embodiment of the present invention in which an IP phone **201** is connected to an adapter **202**. The adapter **202** is configurable to

communicate to a standard cellular network **210**, shown in Figure 2, with two exemplary cells/switches **220** and **203** within that network. The switch **203** is connected via a communications channel **214** to a server **204.** As shown, the server **204** is connected to a packet switching network **206** such as the Internet.

In operation, IP phone **201** may sometimes be located in an area covered by a conventional cellular network **210** and not connected directly to IP network **206**. An adapter **202**, which may also be built into the IP phone **201**, is utilized to implement the connection between one of the cells **220** on cellular network **210**, and the IP phone **201**.

In operation, the IP phone may operate utilizing a conventional cellular telephone network in a manner that is the converse of that previously described with respect to cell phone **101**. More specifically, when the adapter **202** converts IP phone **201** into a type of phone that may be utilized on cellular network **210**, information identifying the cell phone **201** and its temporary phone number on cellular network **210** is transmitted from the cellular network **210** to a server **204** in the IP network **206** via communication line **214**. The communication over line **214** may also be implemented as out of band signaling such as SS7, IP signaling, or any other type of signaling. Notably, by using SS7 or other standardized signaling, the wireless telephony network need not be altered from its present day operation.

Once a server **204** is notified that the IP phone **201** is actually roaming on a cell network **210**, voice and data arriving for the IP phone at IP network **206** are rerouted to the cell network **210** for forwarding to the IP phone **201** over the cell network **210** through adapter **202**.

As explained with reference to Figure 1, the IP phone **201** may be addressed by utilizing a telephone number in the cell network **210**, or an IP address. Alternatively, the addressing scheme and interface may be selected as previously described, either automatically or manually. As explained in the previous embodiment, outgoing calls may be first authenticated and validated via signaling between the home network **206** and the cell network **210** for billing purposes, prior to permitting the outgoing call.

When voice/data travels over the conventional cellular telephony networks, protocols for conventional cellular telephony are used, such as CDMA and other well-known protocols. When voice/data travel over packet switched data networks, the packet

switching protocols such as TCP/IP and other well-known protocols are used. In the case of a single device that can act as a cell phone and IP data device or IP phone, the embodiments of Figures 1 and 2 may be implemented for the same device, depending upon which network is accessed and designated as the home network, and which mode in which the device is operated.

It is understood that the forgoing describes preferred embodiments of the invention, but that various modifications and additions will be apparent to those of skill in the art.

It is also possible that the same phone may act as a cellular phone to provide identifying information to the cellular network and to implement billing, but calls are actually routed to and from an IP network using an IP capability or adaptor with the phone. This, too, can be reversed so that the IP phone communicates billing and authentication information to the IP network, but calls may actually be placed over the cell network from a cell phone, which is potentially the same IP phone in a different mode.

The out of band signaling between the IP network and wireless cell network may also be used to convey data. Instant messaging, for example, utilizes SS7 signaling to convey meaningful data. When a user of cell phone 101 desires to send an instant message ("IM"), the IM is converted to IP by adapter 102 and transmitted to server 106. Server 106 converts the IM to SS7 signaling, and transmits the IM over an SS7 network to switch/server 107. Switch/server 107 may then forward the IM to the cell phone to which it is addressed, either directly or using other SS7 networks, or potentially unrelated networks. Switch/server 107, being related to the home cellular network of cell phone 101, may also be responsible for logging appropriate billing information so that the user gets properly billed for the transmission. It is also possible that the user to which the IM is directed is also within the purview of IP network 105, in which case the IM may go from server 106 directly to an access point or gateway on IP network 105, for forwarding to a destination user.

For an inbound IM utilizing SS7 messaging, assuming the source of the IM is not on IP network 105, such message arrives at server 106 via an SS7 network. The network originally directed the message to home cellular network 112, after which the IM was

directed to server 106 based upon the techniques previously described herein. Upon arrival at server 106, the SS7 message may be converted to IP and forwarded to adapter 102 via IP network 105. Upon arrival at adapter 102, conversion from IP to cellular protocol is accomplished, and the message forwarded through to cell phone 101.

In other embodiments of the invention, any SS7 signaling may be sent via IP between the IP and wireless telephony networks, and out of band signaling may be used to convey a variety of different types of information that may be meaningful to a user, such as instant messaging.

It is also noted that the adapter could be a full PC, whereby call are routed to the address of the PC. Upon recognition by the PC that the incoming data is actually a telephone call, the PC may route the incoming call over a dedicated or other wireless or wired link to a phone, either a normal PSTN phone or a wireless phone. It is also possible to equip the adaptor with a normal PSTN interface, so it can translate between the cell phone protocol and the PSTN protocol. In still another variant of the adapter, the adapter may interface to the cellular network or the PSTN and also have the same functionality of a typical cordless phone, allowing RF communications between a handheld device and the adapter. In this case, the adapter functions as a base station and the handheld device may roam. Software within the adapter receives and transmits PSTN signals, from and to the PSTN, respectively, in accordance with normal telephone protocols, and translates such signals to cellular protocols. The cellular protocols are used to and from the wireless device, possibly over a wireless connection. The PSTN protocols may be used between the adapter and the PSTN, in the normal fashion utilized by a cordless phone base station of the present art. Thus, the adapter may interface between the cell phone and either an IP network, a cell network, a PSTN network or other network. Selection among any one or more such networks can be accomplished as described previously herein.

The foregoing is intended to describe only the preferred embodiments of the invention. Various other modifications and additions will be apparent to those of skill in the art, and are intended to be covered by the claims appended hereto.